Index

A

abiotic factors in ecosystems, 406, 433–39
Aboriginal people. *See* First Nations; First Peoples
absolute age, 310, 324
acceleration
about acceleration, 198–99, 203
about acceleration (speeding up), 195–98
about average acceleration, 199–200
about negative acceleration (slowing or speeding), 202–4, 212
about the displacement equation, 208
about uniform acceleration, 198, 203
deceleration as a term, 212
graphs for, 195, 198–99, 202–4
gravity and, 208
SI symbols and units, 530
zero initial velocity equation, 204
See also displacement; Newton's second law; vehicle stopping distance
acceleration lanes (highways), 206–7
acetic acid, 34–35
acids
about, 50–51
acid rain, 450
See also fatty acids; sulfuric acid
acquired characteristics theory (Lamarck), 501, 509
activity series
for metals and metal ions (table), 79–82, 556
adaptations
about adaptations, 495–96
in snails, 489–96
Agawa Rock, Lake Superior, 69
agents, oxidizing and reducing, 83
agriculture
biomass of wheat fields and grassland, 413
effects of soil salinity on, 409
impact on prairie grassland, 409, 460
air resistance (friction), 228
Alaska, plate tectonics, 358–59
Alaska Earthquake of 1964
events in, 343–44, 349–50
plate tectonics and, 352, 354
Alberta, geological history
about model of (rock column), 312
in Devonian Period, 355
formation of Rocky Mountains, 358–59
glaciers advance on Alberta, 375
in Jurassic Period, 357–58
in Mesozoic Era, 357–59
oldest fossils in Alberta, 304
oldest rocks in Alberta, 297, 301
in Pangaea, 355
in Tertiary Period, 374
in Triassic Period, 357
Alberta, industries. *See* agriculture; forestry and forestry industry; oil and gas industry
Alberta, maps
Athabasca Dunes, 375
Athabasca River, 314
Bearspaw Sea, 369
cross section of rock layers, 338
features 1.5 billion years ago, 302
Lake Edmonton, 383
last glaciation, 367
Slave River rapids, 296
alchemy, 24, 321
algae
about algae and harmful bloom, 409, 450
in carbon cycle (diagram), 444–45
in food chains and food webs (diagram), 428–29
in oxygen cycle (diagram), 448–49
See also aquatic ecosystems
alkanes
about alkanes, 112, 120
addition and substitution reactions, 556
branched alkanes, 116–17
formulas for, 556
homologous series (table), 556
naming alkenes and alkynes, comparison, 127
naming branched alkanes, 117–19, 556
naming continuous alkanes, 114–15, 556
alkenes and alkynes
about, 127
formulas and reactions, 556
alkyl group of branched alkanes, 117
See also alkanes
aluminium
about aluminium, 16
aluminium sulfide (metal ion), 71–72
properties of, 16, 21–23
uses in CDs, 15, 17, 21
See also metals
ammonia and ammonium compounds
in nitrogen cycle (diagram), 450–51
ammonites (fossil), 306–7, 312, 359
amplitude (of waves), 345
Anasazi (Ancestral Pueblo) people, 401
animal fats (food choices), 124–25, 130, 133, 135
anions, 13
Anishinabe (Ojibway) people, 69
anodes, 89–91, 94
See also electrolytic cells; voltaic cells
Antarctica, 376–78, 385, 387–88
applied force, 229
See also Newton's second law
aquatic ecosystems
abiotic and biotic factors in, 406–7
biodiversity loss in, 458–59, 488–89
field study of, 433–39
food chains and food webs (diagram), 428–29
succession in, 473, 475
water pollution and, 442
See also algae
aqueous (water) solutions. *See* solutions
archaeology
copper objects in burial sites, 60–61, 68
handling artifacts, 68
ice mummy, 324
oldest evidence of humans, 93
rock paintings (Agawa Rock), 69
See also fossils
Arctic ecosystems, 465–66, 507, 514
area
SI and non-SI symbols and units, 530–31
area of no return, 216–17, 220
See also vehicle stopping distance
articles, how to cite, 546
asexual reproduction (cloning), 503
asthenosphere, Earth's, 298–300, 352
astronauts, 263
Athabasca Dunes, 375, 380
Athabasca River, 314, 317, 375
atmosphere
impact of cyanobacteria on, 304–5, 312
ozone layer, 447
See also carbon cycle; climate change; nitrogen cycle; oxygen cycle; water cycle
atoms
about, 7–8, 13, 16
atomic number and mass, 7
atomic structure, 16
bonding of, 12–13, 23
breaking chemical bonds, 24–26, 33
collision-reaction theory, 38
periodic table, 10–11, 13, 16, 554–55
See also diagrams of atoms and molecules
automobiles
headlights, 175–77, 239
technological advancements in, 174–78, 257–58
See also fossil fuels; vehicle collisions; vehicle safety
average acceleration, 199–200
average speed
about average speed, 169, 173
average velocity and, 181
average velocity, 181–83, 185

B

bacteria
as first life on Earth, 303–4, 312
nitrogen-fixing bacteria, 416, 417, 450–51
as pioneer species, 471
reproduction of, 483
See also decomposers
bactrites (fossils), 362
Badlands, 292–93, 315
banded iron (iron ore), 304–5
Banff longnose dace, 457
Banff National Park, 315, 358, 478, 488
Banff Springs snail, 488–89
bar graphs, 537
base line and transect (field study), 434
Basic Licence Driver's Handbook, 216
batteries
for consumer use, 92–93, 100, 105, 162
as term for group of cells, 86
See also voltaic cells
battery acid. *See* sulfuric acid
Bearspaw Rock Formation, 306, 312, 324
Bearspaw Sea (maps), 369
beavers, 435, 506
begonias, 407
best-fit lines, 539
bicycle helmets. *See* helmet design
Big Rock, Okotoks, 366–67
bighorn sheep, 492
biodiversity
about biodiversity, 458, 462
in Cambrian Explosion, 335
loss of, 458–62
See also habitat; species
biogeochemical cycles, 443, 452, 466
See also carbon cycle; nitrogen cycle; oxygen cycle; water cycle
biohazardous infectious materials
WHMIS safety cautions, 529
biological communities, 416–17
biomass
biomass pyramid (diagram), 426–27, 432, 441
in prairie grassland ecosystems, 413, 415, 416
Biosphere II project, 516
biotic factors in ecosystems, 406, 422, 433–39
birds
in ecological pyramids (diagrams), 424–28
in food webs (diagram), 430–31
natural selection in finch beaks, 497–500
symbiotic relationships, 416, 417
See also peregrine falcons; yellow warblers; *and specific birds*
bison
history of, 402–3, 413–15, 460
in prairie grassland food webs, 416–17, 431
See also prairie grassland ecosystems
bitumen, 140, 411
Blackfoot people, 366–67, 402, 415
blister copper, 70, 100, 104
Bohr diagrams, 8–9
boreal forest ecosystems
in Alberta, 419
biodiversity loss in, 458–59
as carbon sinks, 443
impact of deforestation on, 442, 446, 456–59
impact of fire on, 440–41, 452, 476–78
stresses on, 455, 460
succession in (diagram), 472
succession process in, 476–78, 481
in world (map), 458
See also forestry and forestry industry
braking distance, 215, 220
See also vehicle braking
branched alkanes
about branched alkanes, 116
naming system for, 117–19, 556
See also alkanes
buffalo. *See* bison
Burgess Shale fossils, 333–35
burrowing owl, 425, 431, 457, 460
butane
about butane as an alkane, 113
diagrams and models of, 111
uses for, 111, 115
butter (animal fats), 124–25, 130, 133, 135

C

calcium carbonate
as metal ions (table and diagram), 71–72
from micro-organisms, 304, 336, 372, 374
calculator, daily water consumption, 412
calculator, ecological footprint, 467
calculator, mole, 67
Cambrian Period
climate in, 334, 384
fossils from, 330, 333–35, 362
life forms in (Cambrian Explosion), 334, 335
Cameron Falls, Waterton Lakes, 302, 303–4
camouflage, as adaptation, 494–95
Canada and North America, maps
Laurentide Ice Sheet, 379, 383
map of West Coast, 363
Precambrian Shield, 297
subduction of plates, 354
tectonic plates of West Coast, 297
***Canadia* (marine worm),** 331, 333
Canadian Shield. See Precambrian Shield
Canadian Space Agency, 377
carbohydrates
in oxygen cycle (diagram), 448–49
carbon
about carbon atoms, 6–7, 109
about carbon-based compounds, 108–10
carbon sinks, 443, 446
diagrams of, 109
how to sketch a diagram of a molecule, 19–20
radioactive dating with isotopes, 323–24, 557
See also hydrocarbons
carbon cycle (diagram), 443–47, 466
carbon dioxide
in carbon cycle (diagram), 443–46
climate change and, 387–88, 446
combustion of hydrocarbons (diagram), 145–47, 556
in oxygen cycle (diagram), 446–49
photosynthesis and, 443
carbonates and carbides, 110
Carboniferous Period, 355
career profiles
accident reconstruction (on CD), 291
ceramic artist (on CD), 161
Columbia Icefield tour guide (on CD), 392
forestry development officer, 510
mechanical engineer, 284
metallurgical engineer, 156
petroleum engineer, 394
rehabilitating injured wildlife (on CD), 467
caribou, woodland, 454, 456–58
carnivores, 424–27
carrying capacity (population), 486
cars. See automobiles
Cascadia Megathrust Earthquake of 1700, 350, 363
catalytic cracking process, 141, 143
See also petroleum
catastrophism, theory of, 314–15
cathodes, 89–91, 94
See also electrolytic cells; voltaic cells
cations, 13, 16
cause, correlation, and probability, 384
CDs, music and data, 15, 17, 21
cell notation, 91
See also voltaic cells
cellular respiration
about process of, 443
in carbon cycle (diagram), 443–47
in oxygen cycle (diagram), 446–49
Cenozoic Era, 368–71
See also Holocene Epoch; Pleistocene Epoch; Quaternary Period; Tertiary Period
centre of mass, 222
See also mass
ceramic artist (on CD), 161

chains, food, 428–32, 441
change in momentum. *See* momentum, change in
chemical changes and reactions
about changes, 25
activity series for metals and metal ions (table), 79–82, 556
collision-reaction theory (diagram), 38
reactivity of hydrocarbons, 132–34
reactivity of metals and metal ions, 77–79
reactivity of noble gases, 12
spontaneous and non-spontaneous, 81
types of reactions, 556
See also electrolytic cells; solutions; voltaic cells (batteries)
chemical equations
about chemical equations, 68
how to check equations (table), 62
how to write word descriptions for equations, 61–62
See also atoms; elements
Chief Louis Clamhouse, 350
Chief Seattle, 3
chlorine, 13, 14, 100
circle graphs, 537
citing sources of information (table), 546
clearcutting, 457, 479–80
climate change
about climate and weather, 382–84
average temperature (1860–2100), 388
average temperature and Geological Time Scale, 384
carbon dioxide emissions and, 387–88, 446
computer modelling of, 382, 385, 393
Earth's rotation and (Milankovitch Theory), 386
global conveyor and, 385
greenhouse effect, 388
plate tectonics theory and, 385
solar intensity variations, 386
temperature and climate radioactive measurements (oxygen isotopes), 372–73, 378
volcanoes and, 357, 386
climax communities
about succession processes, 472–73, 475, 477, 481
in aquatic ecosystems, 473, 475, 481
in boreal forest ecosystem (diagram), 472
in national parks, 478
See also succession (in ecosystems)
cloning (asexual reproduction), 503
closed and open populations, 484, 487
coal, 355, 446, 503
collision-reaction theory, 38
collisions. *See* vehicle collisions
combustible materials
WHMIS safety cautions, 528
combustion of hydrocarbons, 145–47, 556
commensalism (symbiosis), 417
competition in ecosystems, 421
complete structural diagrams, 113, 115
See also diagrams of atoms and molecules
compounds
about carbon-based compounds, 24–26, 33
about compounds, 17
about making compounds, 24, 33
breaking chemical bonds, 24–26, 33
molecular compounds, 19–22
types of reactions, 556
compressed gases
WHMIS safety cautions, 528
concentrated and dilute solutions, 35–39
See also solutions, concentration of
concentration. *See* solutions, concentration of
concept maps, 552
condensed structural diagrams, 113
See also diagrams of atoms and molecules
conductivity meter, 31, 38
coneflowers, purple. *See* purple coneflowers
conservation of energy, law of, 274
conservation of momentum, law of, 268–71
consumers (in ecosystems)
about roles of organisms, 423–26
in carbon cycle (diagram), 444–45
in ecological pyramids (diagrams), 425–27
in food chains and food webs (diagram), 428–31
in four-step process in cycles, 466
in nitrogen cycle (diagram), 450–51
in oxygen cycle (diagram), 446–49
consumption log of water use, 412
continental crust, 298–301
See also crustal plates, Earth's; North American Plate
continental drift, theory of, 354
continental ice sheets, 376–77, 385, 388
continuous-chain alkanes, 113–15, 556
See also alkanes
controlled burning, 440–41, 478
convection currents, Earth's, 299–300
convection currents, oceanic, 385
conversion factors
of one unit to another, 532
conveyor, global, 385
copper
blister copper, 70, 100, 104
copper artifacts, 60–61, 64, 68–69, 86
copper ores and refining, 69–70, 100, 104
uses in society, 17, 60–61, 64, 68–70
corals, 312, 356
cordillera, formation of, 358
core, Earth's
seismic waves and, 347–48
structure of, 298–301, 320
core samples
of continental ice sheets, 378, 387
of ocean sediment, 373
for petroleum exploration, 338–40
correlation, cause, and probability, 384
corrosion, 77, 79
corrosive materials
WHMIS safety cautions, 529
covalent bond, 19
cowbirds, 417
crash test dummies, 187, 273
crash test dummy, egg (activity), 273–79
Cretaceous Period, 358–59, 369, 375
Cretaceous/Tertiary Mass Extinction, 359, 369–70
Crowsnest Volcanics, 312, 323
crude oil. *See* petroleum
crustal plates, Earth's
about continental and oceanic crusts, 298–301
boundaries of, 352–54
density of, 298, 344
rock formation and, 316
Rocky Mountains and (diagrams), 358–59
seismic waves in, 348
subduction of, 344–45, 354
See also plate tectonics
Curie, Marie, 319, 321
cyanobacteria, 303–4, 312
in carbon cycle (diagram), 444–45
in oxygen cycle (diagram), 448–49
cycles
biogeochemical cycles, 443, 452, 466
carbon, 443–47, 466
nitrogen, 450–51, 466
oxygen, 446–49, 458, 466
rock, 317
water, 442–43, 466
Cypress Hills Interprovincial Park, 368, 370
***Cyprimeria* (fossil),** 317–18

D

dangerously reactive materials
WHMIS safety cautions, 529
Darwin, Charles, evolutionary theory, 497–501, 504
See also evolutionary theory
Darwinian fitness, 499–500
daughter isotopes, 321, 557
DDT (pesticide), 404, 428

decane, 115
decay curve, radioactive (graph), 320–22, 557
deceleration lanes (highways), 213
deceleration (slowing down)
use as non-scientific term, 212
See also acceleration
decision-making skills, 548–49
decomposers
about actions on dead organisms, 416, 424
in carbon cycle (diagram), 444–45
in food chains and food webs (diagram), 429–31
in four-step process in cycles, 466
in nitrogen cycle (diagram), 450–51
in oxygen cycle (diagram), 448–49
decomposition as chemical reaction, 556
deep-impact theory (extinctions), 356, 500
deep time, 294–95, 303, 319
deforestation, 442, 446, 456–59
"delta dee." *See* displacement
"delta positive and delta negative," 28
Dene Th'a First Nation
and Slave River, 296
use of salt, 19
denitrification and denitrifying bacteria
in nitrogen cycle (diagram), 450–51
desert ecosystems, 472, 513
Devonian Period, 337–38, 341, 355
diagrams for learning summaries, 552
diagrams of atoms and molecules
about drawing diagrams, 8–10, 16
about three-dimensional models, 28
atomic structure, 16
Bohr diagrams, 8–9
Lewis dot diagrams, 9–10
three-dimensional models, 28
diagrams of hydrocarbons
complete and condensed structural diagrams, 113, 115
line structural diagrams, 115
molecules of carbon and hydrogen, 19–20
didymograptus (fossils), 362
dietary cholesterol, 135
dilute and concentrated solutions, 35–39
See also solutions, concentration of
dimetrodons, 355
Dinosaur Provincial Park, 324
dinosaurs, 357, 369, 500
direction and sign conventions, 180
disabilities technology
improvements in, 85, 184, 190, 192
displacement
about displacement, 181, 185
about displacement equations, 208–12
about resultant displacement, 183, 185
in acceleration, 207–11
acceleration by gravity, 208
dropping vector notations, 212
dissociation of ionic compounds
about dissociation (diagram), 31, 33
See also solutions
dissolving. *See* solutions
distance-time graphs, 169
DNA, 493
dot diagrams, Lewis, 9–10, 28
doubling time (populations), 483
drag force (friction), 228
dragonflies, 428–29, 437
drill-core samples (petroleum), 338–40
drinking water
allowable toxic levels (table), 42
sources of, 380–81
drumlins, 380
dry mass in biomass pyramid, 427, 432

E

Earth
age of, 295, 301, 303
gravity, acceleration due to, 208, 212
internal structure of, 298–301
rotation on axis, 386
See also core, Earth's; crustal plates, Earth's; Geological Time Scale
Earth Simulator, 382, 385, 393
earthquakes
causes of, 344–45, 351
Earth's plates (map), 344
plate tectonics and, 352–54
Richter magnitude, 349–51
seismic waves in, 344–45, 347–51
tsunamis and, 350
ecology
about ecology, 413
economic and ecological systems (table), 460–61
ecological footprint calculator, 467
ecological pyramids (diagrams), 425–27, 432, 441
ecosystems
about abiotic and biotic factors in, 406–7
about roles of organisms in, 423–25
biodiversity loss in, 458–59
biological communities in, 416
competition in, 421
ecological pyramids (diagrams), 425–28, 432, 441
economic systems and (table), 460–61
field study of, 433–39
populations in, 415, 482–87
predator/prey relationships in, 419–21
stresses in, 455–62
symbiosis in, 417–18
trophic levels in, 425–28, 432, 441
See also aquatic ecosystems; Arctic ecosystems; boreal forest ecosystems; extinctions, mass; Great Lakes ecosystems; prairie grassland ecosystems; succession; terrestrial ecosystems
egg test dummy (activity), 273–79
elaidic acid (trans fatty acids), 134
electricity
conductivity meter, 38
electrolytes in solutions (diagram), 31, 33
metal conductors of, 23
SI symbols and units for electric current, 530
in solutions in car batteries, 51
See also voltaic cells
electrodes
about electrodes (diagram), 87, 94
anodes and cathodes, 89–91, 94
cell notation, 91
electroplating, 98–99
electrolysis, 100
electrolytic cells
about electrolytic cells (diagram), 95, 101
for refining ores (diagram), 100
uses for, 97–100
voltaic cells, comparison (diagram), 95
electrons
about electrons, 6–8, 13, 16
gaining, losing, and sharing, 12–13, 16
transfer in redox reactions, 71–75
valence electrons, 12–13
See also atoms
electroplating, 97–98
See also electrolytic cells
elements
about elements, 6, 13
isotopes, 321, 557
metals and non-metals, 16
periodic table, 10–11, 13, 16, 554–55
for radioactive dating (table), 557
types of reactions, 556
Elk Island National Park, 478, 484
elk populations, 484
embryos and evolutionary theory, 502
emigration and immigration, 484, 487
endangered species
about species, 454
examples of, 425, 488
as species at risk (table), 457
endothermic change, 25
energy
about energy and work, 274

in ecological pyramids (diagrams), 425–27, 432, 441
in ecosystems, 432, 441
exothermic and endothermic reactions, 25
in food chains and food webs, 432, 441
in food chains and food webs (diagram), 428–30
SI symbols and units, 530
from Sun, 423, 441
energy level, 8
See also electrons
energy pyramid (diagram), 425–27, 432, 441
engineers
forensic, 264, 271
mechanical, 284
metallurgical, 156
environmental protection. *See* stewardship, environmental
epicentre
in an earthquake, 344–45, 351
seismic waves and, 347–49
epochs and eras, 312, 557
erosion, 315, 368, 447
essential fatty acids, 125
See also fatty acids
ethane
about ethane as an alkane, 113
melting and boiling points, 132
naming of continuous alkanes, 114–15, 556
as saturated hydrocarbon, 123
uses for, 115
ethenes and ethynes
molecular models of, 111
production of ethenes (diagram), 141
reactivity of, 132
uses for, 111, 142
Europe, climate of, 385–86
evolutionary theory
about theory of evolution, 499–500, 504
additional evidence to support, 502, 504
Darwinian fitness, 499–500
Darwin's theory, 497–504
Lamarck's theory of acquired characteristics, 501
reproduction and, 503
See also populations
exothermic change, 25
explosions (biological diversity), 335
explosions (populations), 485
explosions (seismic energy), 340–41
explosions (type of interaction), 265–67, 271
exponential curve and exponential growth (populations), 483
extinct species
about species at risk (table), 457
statistics on, 403, 462
extinctions, mass
causes and occurrences, 356–57, 386, 500
in Cretaceous Period, 356, 359, 369–70
trends in present time, 462
extirpated species (table), 457

F

fast neutrons, 323
fatty acids
about fatty acids (diagrams), 124–25, 134
essential fatty acids, 125
food choices and, 125, 135
hydrogenated and plant and animal fats, comparison, 134–35
mono- and polyunsaturated fats, 125, 135
omega-3, omega-6, and omega-9, 125, 134
trans fat and trans fatty acids, 134–35
fault (in Earth's crust), 344
fertilizers, 408–9, 450
finches (beaks), 497–500
fires
about fire in ecosystems, 440–41, 452, 478
controlled burning, 440–41, 478
impact on nitrogen cycle (diagram), 450
impact on oxygen cycle, 447
impact on succession, 476–78
impact on water cycle, 442
First Nations
bison and, 402–3, 414–15, 460
burial site at Prince Rupert Harbour, 60–61, 68, 86
life on Slave River, 296
oral traditions, 350, 366, 383, 501
rock paintings, 69
stewardship and, 3, 510
travel by hunters, 168
use of controlled burning, 478
use of medicine wheels, 414–15
use of purple coneflowers, 418
use of salt, 19
First Peoples
ancestors, 294
stakeholder group, 480
traditional stories, 383, 501
See also First Nations; Inuit; Métis, fur trade
fish
in food chains and food webs (diagram), 428–29
PCBs in, 35
fishing flies, 406–7
flammable materials
WHMIS safety cautions, 528
fluid friction, 228
focus (earthquakes), 344–45
food chains and food webs, 428–32, 441
foods
nutrition labels, 125
PCBs in fish, 35
See also fatty acids
***Foraminifera*,** 372–73, 374
force
applied force, 229
friction, 221, 226, 228, 234
in Newton's first law, 231, 234, 243
in Newton's second law, 225–26
in Newton's third law, 258–62
SI symbols and units, 530
See also net force
forensic engineering, 264, 271
forest fires. *See* fires
Forest Stewardship Council (FSC), 480–81
forestry and forestry industry
boreal and rain forests in world (map), 458
forestry officer (career), 510
habitat destruction and fragmentation by, 455–61
harvesting methods, 479–80
impacts of deforestation, 442, 446, 456–59
sustainable development, 479–81
forests, boreal. See boreal forest ecosystems
Fort McMurray, 314, 317–18, 411
fossils
about fossils, 302
about fossil record, 489
about fossilization, 330, 333–35
in Burgess Shale, 333–35
in drill-core samples, 339–40
index fossils, 310–12, 330, 356, 362
interpretation of, 332–33, 335
mass extinctions and, 356, 462
modern organisms and, 331–33
oldest fossils in Alberta, 304
radioactive dating of, 321–24
in sedimentary rock (diagrams), 308, 334
shark-tooth fossils, 307–8
snail shell adaptations, 495–96
snail shells in fossils (table), 489
stewardship of, 335
trace fossils, 304, 331
See also ammonites; stromatolites; trilobites
fossil fuels
in carbon cycle (diagram), 443–46
coal, 355, 446, 503
combustion of hydrocarbons (diagram), 145–47, 556
environmental impact of burning, 147
formation of, 336–38, 341
natural gas, 145

in oxygen cycle (diagram), 448–49
in subsurface rock (map), 338
See also oil and gas industry
fox, swift, 425, 430, 457
fractional distillation
of petroleum (diagram), 138–41
fractions for unit conversions, 532
freshwater ecosystems. See aquatic ecosystems
friction, 221, 226, 228, 234
FSC (Forest Stewardship Council), 480–81
fuels from hydrocarbons. See fossil fuels

G

Galapagos Islands, Darwin in, 497–99
gases, compressed
WHMIS safety cautions, 528
gasoline, 140
See also fossil fuels
generation (adaptations), 489
genetics
about genes and DNA molecules, 492–93, 496
biodiversity loss and, 458–59
as evidence for evolutionary theory, 502
Lamarck's theory and, 501
Geological Time Scale
about (chart), 312, 557
average global temperature and (chart), 384
cylinder model of, 313
dating methods for, 312, 317, 324
geology, theories and technologies
catastrophism, 314–15
deep time, 294–95, 303, 319
mass spectrometer, 321
relative dating, 308, 310
uniformitarianism, 315, 317, 319
geophones, 341, 455
germination, seed, 408–9
giant water bug, 429
giraffes, 501
glacial landforms, 366–67, 380–81
glaciations and glaciers
about glaciations (ice ages), 377, 385
causes of, 385–87
last glaciation (map), 367
last glaciation (Wisconsin Glaciation), 367, 379–81
mass extinctions and glaciation, 356
mountain glaciers, 376, 380
global conveyor, 385
Global Positioning System, 354
global warming. See climate change
glossary, 518–25
gneiss, 322
gold
in consumer products, 17, 21, 84–85, 99
properties of, 76–77, 84–85
Gold Rush, Klondike, 76
GPS systems, 354
gradualism (adaptations), 492, 500
granite, 296–98, 301
graphic organizers, 552
graphs
how to create scatterplots, 538–39
how to use types of, 537–38
See also time, in graphs
graptolite (fossils), 362
grasses
in food webs (diagram), 430–31
in prairie grassland ecosystems, 415–16
as producers, 425–27
in Tertiary Period, 371, 374
grasshoppers, 423–28, 431
grasslands, prairie. See prairie grassland ecosystems
gravity
acceleration due to, 208, 212
gravitational potential energy, 274
great horned owl, 421
Great Lakes ecosystems, 459
grebes, 429
greenhouse effect, 388
See also climate change
Greenland Ice Sheet, 376, 385, 388

H

habitat
about habitats, 407
biodiversity loss and, 458–61
biomass in, 413
habitat destruction and fragmentation, 455–57
for plants, 407–8
See also species
half-lives
radioactive decay curve (graph), 320–22, 557
half-reactions in activity series
for metals and metal ions (table), 81–82, 556
***Hallucigenia* (fossil),** 332–33
halogen-bulb headlights, 175–76, 239
Handhills Formation, 370
hares. *See* snowshoe hare
harmful algal bloom, 409
See also algae
hawks, red-tailed, 419, 430
head restraints, 232–33
Head-Smashed-In Buffalo Jump, 402, 414
head-to-tail method (scale diagram)
for resultant displacement, 183, 185
heart disease risks, 135
heat
in energy pyramid (diagram), 425–27, 432, 441
metals as conductors, 23
helium, 12
helmet design
egg test dummy (activity), 273–79
injury reduction and, 272–73, 280
heptane, 115
herbivores (primary consumers), 423, 425
See also consumers (in ecosystems)
hexane, 115
high-intensity discharge (HID) headlights, 176–77, 239
Holocene Epoch
average global temperatures in (charts), 384, 388
in Geological Time Scale, 312, 368, 557
Laurentide Ice Sheet (maps), 379–80, 383
oldest evidence of humans, 383
time frame, 383
homologous series of alkanes (table), 556
hoodoos, Drumheller area, 292–93, 315
humidity, 442
humus, 471–72
Hutton, James, 315–17
hydrogen
about hydrogen atoms, 7, 109
diagrams of, 19–20, 109
See also hydrocarbons; water molecules
hydrocarbons
about hydrocarbons, 111
about carbon-based compounds, 108–10
about diagrams of, 109, 113, 115
alkenes and alkynes, 127
boiling and melting points, 132, 140
combustion of hydrocarbons, 145–47, 556
general formulas (alkane, alkene, alkyne), 556
homologous series of alkanes (table), 556
in natural gas, 145
physical and chemical properties, 130
polymers, 149–51
prefixes for molecular compounds, 556
reactivity of, 132
types of reactions, 556
See also alkanes; diagrams of hydrocarbons; petroleum
hydrocarbons, saturated and unsaturated
about bonds in (diagrams), 123, 135
healthy food choices, 135
hydrogenation, 133–35
industrially produced trans fatty acids, 133–35
physical and chemical properties, 130–33
production in cracking, 143
reactivity of, 132

hydrogenation, 133–35
See also hydrocarbons, saturated and unsaturated
hydrosphere, 385
hypoxic tents, 446

I

ice ages, 377
See also glaciations and glaciers
ice-core samples (Vostok), 378, 387
ice mummy (Italian Alps), 324
ice sheets, continental, 376–77, 385, 388
icebergs, 376
igneous rocks, 316–17
See also rocks
immigration and emigration, 484, 487
impulse
about impulse, 252–56
SI symbols and units, 530
in situ bitumen extraction method (oil sands), 411
index fossils. *See* fossils
industrially produced trans fat and trans fatty acids, 134–35
See also fatty acids
inertia
about inertia, 233–34
See also Newton's first law of motion
infectious materials
WHMIS safety cautions, 529
inheritance of acquired characteristics (Lamarck), 501, 509
instantaneous speed, 170, 173
intersections, traffic, 216–20
See also vehicle stopping distance
intrusion (geology), 308
Inuit
copper jewellery, 64
Inuktitut, 368
Malemiut Inupiat people, 249
invasive species, 459–60
ions
about, 13
collision-reaction theory, 38
metal ions (table and diagram), 71–72
in redox reactions, 72–75
spectator ions, 75
ionic bonds, 17
See also ionic compounds
ionic compounds
about ionic bonds and compounds, 17
as category of matter (table), 21
dissociation in solutions (diagram), 31, 33
metals as ionic crystals (diagram), 72
properties of, 22, 23
redox reactions, 72–75
water as solvent (diagrams), 27, 29
IPCC (U.N. Intergov't. Panel on Climate Change), 393
iron
corrosion of, 79, 95
in Earth's core, 298, 301
electroplating of, 98–99
iron oxide in rocks, 304–5
iron sulfide (metal ion), 71–72
isotopes
radioactive decay curve (graph), 320–22, 557
IUPAC naming system (alkanes), 114–19, 556

J

J-curve (populations), 483, 487
Jasper National Park, 358
jewellery, gold, 99
Juan de Fuca Plate, 363
Jurassic Period
dinosaurs in, 357, 358
formation of Rocky Mountains in, 358–59

K

keystone species, 458
kinetic energy, 274
Klondike Gold Rush, 76

L

laboratory safety, 527–29
Lake Edmonton, 383
Lake Vostok, Antarctica, 378, 387
Lamarck, Jean-Baptiste, 501, 509
land snails. *See* snails
last glaciation (Wisconsin Glaciation). *See* glaciations and glaciers
Laurentide Ice Sheet (maps), 379–80, 383
See also glaciations and glaciers
lava, 470
See also magma; volcanoes
lava lamp, convection currents in, 301
law of conservation of energy, 274
law of conservation of momentum, 268–71
law of superposition, 308, 310, 315
laws, Newton's. *See* Newton's first law of motion; Newton's second law of motion; Newton's third law of motion
Le May Doan, Catriona, 178
Leduc #1 oil well, 336, 340
leeches, 429
lemmings, 465
length
SI symbols and units, 530
lesson answers, 558–65
Lewis dot diagrams, 9–10, 28
lichens, 454–55, 457, 471–72
limestone, 304, 339, 374
line structural diagrams, 115
See also diagrams of atoms and molecules
lithium, 80, 92
lithosphere, Earth's, 298–99, 348
See also crustal plates, Earth's
Little Ice Age, 386, 389
lodgepole pines, 441, 479
log of water consumption, 412
logging. *See* forestry and forestry industry
longitudinal waves, seismic, 347
luminous intensity
SI symbols and units, 530
lupins, 450
Lyell, Charles, 317
lynx, 419–21, 514–15

M

magma
in Earth's structure, 298, 301, 317, 352, 470
as igneous rocks, 308, 316–17
paleomagnetism and, 300–301
magnetic fields, Earth's, 298, 300–301
magnitude (in vectors), 180, 183, 185
malamute dogs, 249
malaria, 509
Malemiut Inupiat people, 249
Malthus, Thomas, 486
mammals, history of
in Pleistocene Epoch, 377
in Tertiary Period, 370, 371
mammoths, woolly, 377
mantle, Earth's, 298–99
map skills, 179–85
maps. *See* Alberta, maps; Canada and North America, maps; world, maps
margarine (vegetable oils), 124–25, 130, 133, 135
Mars, terraforming of, 473
mass
about mass, 222, 242
inertia and, 233
momentum and, 243, 245
SI and non-SI symbols and units, 531
mass extinctions. *See* extinctions, mass
mass number, 7
mass spectrometer, 321
matter
categories of (table), 21–23
conservation of matter in equations, 61–62

matter, recycling of
in biogeochemical cycles, 466
in food chains and food webs, 432
See also carbon cycle; nitrogen cycle; oxygen cycle; water cycle
Maunder Minimum (sunspots), 386
Mayan people, 477
measurement. *See* units of measurement
mechanical engineer (career), 284
medicine wheels, 414–15
melting points of hydrocarbons, 132
mesosaurus, 355
mesosphere, Earth's, 298–99
Mesozoic Era
extinction in, 359, 369–70, 374
formation of Rocky Mountains, 358–59
in Geological Time Scale, 312–13, 557
See also Cretaceous Period; Jurassic Period; Triassic Period
metals
about metals, 16
activity series, 79–82, 556
as category of matter (table), 21
cations, 16
as electricity conductors, 23
electrolytic cells for refining (diagram), 100
as heat conductors, 23
in periodic table, 16, 554–55
properties of, 16, 22–23
reactivity of, 77–79
reactivity with metal ions, comparison, 79
redox reactions, 72–75
See also aluminium
metal ions
in activity series (table), 79–82, 556
metal ions (table and diagram), 71–72
reactivity of, 77–79
reactivity with metals, comparison, 79
redox reactions, 72–75
metal ores
about metal ores, 69–71
redox reactions to purify, 73–75
metamorphic rocks, 316–17
See also rocks
meteorites and deep-impact theory, 468–69, 500
methane
about methane as an alkane, 113
combustion of (diagram), 145–47, 556
as continuous-chain alkane, 114–15
as greenhouse gas, 117
melting and boiling points, 132
naming of continuous-chain alkanes, 114–15, 556
uses for, 115, 117
Métis, fur trade, 420
micro-organisms. *See* bacteria
Milankovitch Theory, 386
molar concentrations (solutions)
about, 40, 44–46
about mole ratios in chemical equations, 62–63, 68
about moles and molar mass, 44–45
mole calculators, 67
SI symbols and units, 530
See also solutions, concentration of
molecules and molecular compounds
about, 19–21
as category of matter (table), 21
collision-reaction theory, 38
prefixes for (table), 556
properties of, 22
See also diagrams of atoms and molecules
momentum
about momentum, 243, 245
law of conservation of, 268–71
Newton's first law and, 243
SI symbols and units, 530
sports equipment and, 242–44
momentum, change in
about change in momentum, 246–47, 251
calculating the change, 249–50
Newton's second law and, 246–47, 251
monkey tails, 509
monounsaturated fats, 125
See also fatty acids
Moon rocks, 323
moraines, 380
Morley Flats, 380
morphology (adaptations), 489
mosquitoes, 428–29, 509
moth, peppered, 503
motor vehicles. *See* vehicle collisions; vehicle safety
Mount Michener, 352
Mount Pinatubo, 357, 386
Mount Rundle, 312, 315
Mount St. Helens, 508
Mount Tambora, 357
Mount Toba, 401
Mount Wapta, 328, 331, 332, 333
mountain glaciers, 376, 380
***Mucrospirifer* (fossil),** 317–18, 362
mummy, ice (in Italian Alps), 324
musk-oxen, 465
muskeg (peat bogs). *See* peat bogs (muskeg)
mutation (adaptations), 493, 496
mutualism (symbiosis), 417

N

naming system (IUPAC)
for alkenes and alkynes, 127
for branched alkanes, 117–19, 556
for continuous alkanes, 114–15, 556
national parks
secondary succession in, 478
See also Banff National Park; Elk Island National Park
Native people. See First Nations; First Peoples
natural gas
as mixture of hydrocarbons, 145
See also fossil fuels; methane; oil and gas industry
natural selection theory, 499–500, 503
negative acceleration, 202–4, 212
nematodes, 416, 430
net force
about net force, 221, 234
applied force and, 229
in braking, 221
inertia and, 234
momentum and, 246
newton as common unit, 221, 225–26, 234
neutrons, 6–7, 13
See also atoms
Newton, Sir Isaac, 252
newton (unit of force), 221, 225, 253
Newton's first law of motion
about Newton's first law, 231, 234, 243
inertia and, 233, 234
momentum and, 243
See also momentum
Newton's second law of motion
about Newton's second law, 225–26
applied force, 229
change in momentum and, 246–47, 251
impulse and, 252–56
interaction of objects and, 259–61
rate of acceleration, factors in, 229–30
Newton's third law of motion, 258–62
nitrogen
about denitrification and denitrifying bacteria, 450–51
about nitrogen fixation and nitrification, 450–51
in fertilizers, 409, 450
nitrifying bacteria, 416, 417, 450–51
nitrogen cycle (diagrams), 450–51, 466
noble gases, 12–13
nomogram, Richter, 364
non-electrolytes, 31
non-metals
anions, 16

in periodic table, 16, 554–55
purifying with electrolytic cells (diagram), 100
non-spontaneous chemical reactions, 81
non-uniform motion, 169–70, 173
nonane, 115
North America, maps of. See Canada and North America, maps
North American Plate
as continental crustal plate, 298–301
earthquakes and motion of, 344
North Atlantic Conveyor, 389
North Magnetic Pole, 301
northern pike, 428–29
nucleus of an atom, 7–8
See also atoms
numbers pyramid (diagram), 427, 432, 441
nutrients, 408–9, 416
nutrition labels, 125

O

oceans, global conveyor in, 385
oceanic crust, 298–301
See also crustal plates, Earth's; Pacific Plate
octane, 115, 132
oil and gas industry
extraction technologies (diagrams), 410–11
Leduc #1 oil well, 336, 340
oil refineries, 138–41
oil sands, 314, 317–18, 411
petroleum engineer (career), 394
seismic exploration, 340–41, 455–56, 458
seismic exploration (diagrams), 341, 455
See also fossil fuels; petroleum
Okotoks, 366–67
oleic acid (in vegetable oils), 124–25, 134
omega-3, omega-6, omega-9 fatty acids, 125, 134–35
See also fatty acids
omnivores, 424–26
***Onychophora*,** 332–33
open and closed populations, 484, 487
Ordovician Period, 336–37, 341
ores
about metal ores, 69–71
redox reactions to purify, 73–75
organic, as term, 110
organic chemistry, 108, 110
Ottawa, 64, 236–38
outcrops, 297, 302, 308, 324, 361
See also rocks
owls
about, 421, 425, 431, 457, 460
motion in catching prey, 172, 246
oxidation
about oxidation, 72, 75
corrosion as, 77
oxidizing agents, 83
redox reactions, 72–75
See also voltaic cells
oxidizing materials
WHMIS safety cautions, 528
oxy-acetylene welding, 127
oxygen
atomic diagrams of, 10
cyanobacteria as source of, 304
in hydrocarbon combustion reactions, 145–47, 556
oxygen isotopes and temperature measurements, 372–73, 378
See also water molecules
oxygen cycle (diagrams), 446–49, 458, 466
ozone, 447–49

P

P-waves (seismic), 345–49
Pachena people, 350
Pacific Plate
as an oceanic crustal plate, 298–301
earthquakes and motion of, 344
map of West Coast, 363
Pacific yew, 459
paclitaxel, 112
paleomagnetism, 300–301
Paleozoic Era
biological diversity in, 335
in Geological Time Scale, 312–13, 557
See also Cambrian Period; Devonian Period; Ordovician Period; Permian Period; Silurian Period
Pangaea (supercontinent), 354–59
paper industry, 454, 456
parasitism (symbiosis), 417
parent isotopes, 321, 557
partial hydrogenation, 133–35
parts per million (solutions), 40, 42–44
See also solutions, concentration of
peat bogs (muskeg), 443, 446
pentane
diagrams and models, 115
melting and boiling points, 132
uses for, 115
peppered moths, 503
percent by volume (solutions), 40–42
See also solutions, concentration of
perch, 429
peregrine falcons, 404–5, 424–28, 457
periodic table of elements
about periodic table, 10–11, 13, 16, 554–55
periods (Geological Time Scale), 312, 557
Permian Period, 355–56, 386
pesticides, 404, 428
petroleum
about petroleum, 137–38, 143
about petroleum traps (diagrams), 338
about petroleum formation, 337–39, 341
cracking process (diagram), 141, 143
fractional distillation (diagrams), 140–41
See also fossil fuels; oil and gas industry; petrochemicals
petrochemicals
about petrochemicals, 144
production from distillation, 140
use for fuel, 151
See also fossil fuels; plastics (polymers)
petroleum engineer (career), 394
petunias, 407
pharmaceutical drugs and biodiversity, 112, 459
photosynthesis
about process of, 443
in carbon cycle (diagram), 443–47
first photosynthetic organisms, 303–4
in four-step process in cycles, 466
in oxygen cycle (diagram), 446–49
by producers in ecosystems, 423, 426, 441
See also algae
pine trees, 441
See also boreal forest ecosystems
pioneer species (succession), 471–73, 475
plankton, 337–38, 359
plants
in carbon cycle (diagram), 444–46
first land plants as fossils, 336
habitats for, 407–9
impact of fire on growth of, 441, 450
in nitrogen cycle (diagram), 450–51
nitrogen-fixing bacteria on roots of, 416, 417, 450–51
nutrients for, 408–9, 450
in oxygen cycle (diagram), 448–49
salinity and seed germination, 408–9
transpiration, 442
See also succession (in ecosystems)
plastic substances, 298
plastics (polymers)
about polymers, 149–51
environmental impact of, 21, 150–51
as molecular compounds, 19, 21–22
uses and recycling of, 15, 17, 21, 150–51
plate tectonics
about theory of, 300–301
climate change and, 385
mapping crustal plates, 352–54, 363

Rocky Mountains and (diagrams), 358–59
subduction and, 344–45, 354
See also crustal plates, Earth's
Pleistocene Epoch
climate in, 375, 381, 384, 385
glaciations in, 375–77, 379, 385, 386
life forms in, 377
poisonous materials
WHMIS safety cautions, 529
polar ice sheets. *See* Antarctica; Greenland Ice Sheet
pollen and pollination, 371
polychlorinated biphenyls (PCBs), 35
polyethylene, 141
polymers, 149–51
See also plastics (polymers)
polyunsaturated fats, 125
See also fatty acids
populations
about populations, 415
about changes in populations, 482–87, 492–93
adaptations in, 488–96
types of reproduction (sexual and asexual), 503–4
See also evolutionary theory
position (distance and direction), 180–81, 185
position-time graphs
in accelerated motion, 195, 198
in uniform motion, 187, 189, 192, 195
power
SI symbols and units, 530
prairie dogs
in food webs (diagram), 430
in grassland ecosystems, 413
impact of humans on, 458, 460
predators of, 419
symbiotic relationships, 416–17
prairie grassland ecosystems
biological community in, 415–17
biomass in, 413, 415
climax community in, 472, 481
competition in, 421
consumers and producers in, 423–24
ecological pyramids in (diagrams), 425–27, 432, 441
food chains and food webs (diagram), 428, 430–31
impact of agriculture on, 460
impact of fire on, 441
predator-prey population dynamics, 419–21
in Tertiary Period, 371
See also bison; prairie dogs
Precambrian Era
climate, 305, 384
geological features and life forms, 302–5
in Geological Time Scale, 312–13, 557
Precambrian Shield (Canadian Shield)
formation of Rocky Mountains, 358–59
regions of (map), 297
Slave Granite as part of, 296–98, 301
subsurface rock under Alberta (map), 338
precipitates in solutions (diagram), 27
predation (predator and prey), 419–22, 469
prefixes
for branched alkanes, 117, 556
for continuous alkanes, 114–15, 556
for molecular compounds (table), 556
for SI units (table), 531
prescribed burning (fires), 441, 478
pressure
SI symbols and units, 530
primary consumers, 423–24
See also consumers (in ecosystems)
primary succession, 470–75
See also succession (in ecosystems)
primary waves, seismic, 345–49
Prince Rupert Harbour, burial site, 60–61, 68
probability, correlation, and cause, 384
producers (in ecosystems)
about roles of, 423–24, 428
in ecological pyramids (diagrams), 425–27, 441
propane
about propane as an alkane, 112–13
naming of continuous alkanes, 114–15, 556
uses for, 115
properties of matter
about properties, 21–24
in categories of matter (table), 21
of compounds, 107
physical and chemical properties, 130
qualitative properties of solutions (diagram), 37–38
protons, 6–7, 13
See also atoms
punctuated equilibrium (adaptations), 492, 500
purple coneflowers, 418, 425–28, 430
purple loosestrife, 460
PVC (polyvinyl chloride), 111
pyramids, ecological (diagrams), 425–27, 432, 441

Q

qualitative property of a solution (diagram), 37–38
quartzite, 367
Quaternary Period, 381, 384
See also Holocene Epoch; Pleistocene Epoch

R

rabbit populations, 485
radioactive dating, 323–24
radioactivity
about radioactive decay curve, 320–22, 557
oxygen isotopes and environments, 372–73, 378
radioisotopes (table), 557
use for dating, 319–24
rain forests, 458
Ramskold, Lars, 332–33
reaction distance, 214–15
See also vehicle stopping distance
reaction time, 167, 214–15
reactions, chemical. *See* chemical changes and reactions
recycling
about rethink, reduce, re-use, recycle, 150, 454, 461–62
of electronic equipment, 84
of plastics, 21, 150–51
of voltaic cells, 93
See also matter, recycling of; stewardship, environmental
Red Deer River, 324
Red Rock Coulee, 315
red-tailed hawks, 419, 430
redox reactions (reduction and oxidation)
oxidizing and reducing agents, 83
transfer of electrons in, 72–75
reduction processes
about gain of electrons, 73–75
reducing agents, 83
reefs, formation of, 334, 336–37, 341
reference point in position, 180, 185
refining ores (diagram), 100
reforestation programs, 479–80
See also forestry and forestry industry
relative age and dating, 308, 310
resistance (friction), 228, 234
respiration, cellular. *See* cellular respiration
resultant displacement, 183, 185
See also displacement
Richter magnitude (earthquakes), 349–51, 364
robotics, 187, 190–91, 193, 473
rocks
about formation and types of (charts), 316–17
about rock cycle (diagram), 317
absolute age, 310, 324
intrusions, 308
outcrops, 297, 302, 308, 324, 361
radioactive dating of, 321–23
relative dating of, 308, 310, 315
strata and stratigraphic sequence, 308

See also igneous rocks; metamorphic rocks; sedimentary rocks
Rocky Mountains
formation of (diagrams), 358–59
impact of glaciers on, 376, 380
rolling resistance (friction), 228
rubrics
for defending a position, 549
for evaluating a position, 549
for identifying perspectives, 548
for learning summaries, 553
for researching an issue, 548
for risk-benefit analysis, 548
for self-assessment, 547
ruminants, 371
Rutherford, Ernest, 319–21

S

S-curve (populations), 486, 487
S-waves (seismic), 345–49
safety, transportation. *See* traffic safety; vehicle safety
safety procedures
for diluting acids, 50
in a field study, 433
in science laboratories, 527–29
Sakawinowak (Woodland Cree), 168
salt bridges. *See* voltaic cells
salts
salinity and seed germination, 408–9
sand dunes, Athabasca, 375, 380
sandstone, 339
Sarcee people, 366
satellite technology, 377, 382
saturated hydrocarbons, 123
See also hydrocarbons, saturated and unsaturated
scalar quantities, 170–71, 181
scale diagrams
for resultant displacement, 183, 185
scatterplots, 538
scavengers, 424
science laboratories, safety in, 527–29
science skills (table), 540
scientific notation, calculators for, 43–44
sea-floor spreading, 300–301
seat belts, 232–33
secondary consumers, 424
See also consumers (in ecosystems)
secondary succession, 476–81
See also succession (in ecosystems)
secondary waves, seismic, 345–49
sedimentary rocks
about formation of (charts), 308, 316–17
banded iron formations in, 304–5
law of superposition, 308, 310, 315
petroleum reserves in (map), 338
See also fossils
sedimentation rates, 303
seismic waves
about properties of (chart), 348
about types and speeds of, 345–49, 351
in earthquakes (diagrams), 344–45, 347–51
in oil and gas exploration (diagrams), 340–41, 455–56
seismographs and seismograms, 341, 343, 349, 364
self-assessment rubric, 547
sexual reproduction, 503–4
shale, 333–35, 338
shampoo and conditioners, chemistry of, 56, 159
shark-tooth fossils, 307–8
shells, snail. *See* snails
sickle cell anemia, 509
sign convention, 180
significant digits
adding and subtracting, 535
calculations with, 534–36
exact values, 534
multiplying and dividing, 536
rounding, 534
Siksikaitsitapi people, 415
Silurian Period, 337, 341
silver
silver oxide and silver sulfide (metal ions), 71–72
silver sulfide tarnish, 61–62, 65
single replacement reactions, 74–75
sinks, carbon. *See* carbon cycle
skateboards, 222, 258
skating, ice, 259
skunks, 424
Slave Granite, 296–98, 301
Slave River rapids (map), 296
sled dogs, 249
sleds, 227
slowing down. *See* acceleration; deceleration
Smith, William, 310–11, 313, 314
snails
about snails, 488–89
adaptations in shells, 489–96
fossil evidence of (table), 489
Snowball Earth, 305, 384
snowboards, 222
snowshoe hare
predator-prey populations, 419–21, 514–15
sodium, 12, 13
sodium bicarbonate (baking soda), 65
sodium chloride (rock salt)
about rock salt, 17–18
in aqueous solutions (diagram), 26
effects on seed germination, 408–9
in food, 12
as ionic compound, 17–18, 22
properties of, 21
use in society, 19
soils
impact of prairie dogs on, 416–17
impact of wildfires on, 450, 452
micro-organisms in, 416, 417
neutralization of acidic, 68
salinity and seed germination, 408–9
in succession, 471–73, 477, 481
solar energy. *See* Sun
solutes and solvents (diagram), 26
solutions
about solutions (diagrams), 26–27
aqueous solutions, 26–31, 33
dissociation of ionic compounds, 31, 33
electrolytes and non-electrolytes in, 33, 38
electrolytes in (diagram), 31
qualitative properties (diagram), 37–38
safety procedures for diluting acids, 50
solutes not dissolved in water (diagram), 30
speed of reactions (diagram), 39
solutions, concentration of
about concentrated and dilute solutions, 35–39
diluting acids, 50
diluting solutions (diagram), 48
expression of concentration (table), 40
molar concentration, 40
parts per million, 40, 42–44
percent by volume, 40–42
procedures for changing, 42
reduced concentrations, 36–37
standard solutions, 46
song thrush, 496
species
biodiversity loss and, 458–59
invasive species, 459–60
species at risk (table), 457
See also habitat; trophic levels
spectator ions in chemical reactions, 74
spectrometer, mass, 321, 324
speed, average. *See* average speed
speed, instantaneous, 170, 173
speed limits, 170, 216
sponges, 336, 337
spontaneous chemical reactions (table), 81
sports equipment, 242–44
See also helmet design
spruce trees, 472
See also boreal forest ecosystems

stakeholders, identifying views of, 548
standard solutions, 46
stearic acid (in butter), 124–25
Steno, Nicolas, 307–8, 313, 315
stewardship, environmental
about need for, 510
about sustainable development, 479–81
controlled burning, 440–41, 478
ecological footprint calculator, 467
First Peoples and, 3, 510
fossil fuel combustion, 147–48
of fossils, 335
impact of agriculture, 409, 460
impact of plastics, 21, 150–51
ozone layer and pollution, 447
pollution from automobiles, 111
rethink, reduce, re-use, recycle, 150, 454, 461–62
species at risk (table), 457
threatened species and need for, 404
See also career profiles; water and society
stickleback, 429
Stoney people, 366
stopping distance, vehicle. *See* vehicle stopping distance
strata and stratigraphic sequence, 302, 308
See also sedimentary rocks
stromatolites (fossils), 294, 303–4, 312
subduction of Earth's plates, 344–45
See also crustal plates, Earth's
substance, amount of
SI symbols and units, 530
succession (in ecosystems)
in boreal forest ecosystem (diagram), 472
primary succession, 470–75
secondary succession, 476–81
See also climax communities
sulfur dioxide
blister copper and, 70, 100, 104
sulfuric acid
as acid, 50–51
silver sulfide tarnish (diagram), 61–62, 65
Sun
Earth's orbit and glaciations, 386
as energy source for ecosystems, 423, 425–26, 441
ozone layer and, 447
variations in energy from, 386
supercontinent (Pangaea), 354–59
superposition, law of, 308, 310, 315
surface waves, seismic, 348–49
surfactants, 56, 159
survival of the fittest. *See* natural selection theory
sustainable development, 479–81
See also stewardship, environmental
Swan Hills forest ecosystem, 455
swift fox, 425, 430, 457
swimming, 259
symbiosis, 417–18, 422

T

tarnishing of metals, 61–62, 65
tectonics, plate. *See* plate tectonics
temperature
SI and non-SI symbols and units, 531
temperature and climate
fluctuations in Earth's (charts), 384, 388
See also climate change
terraforming, 473
terrestrial ecosystems
field study of, 433–39
succession from aquatic to, 473
See also boreal forest ecosystems; prairie grassland ecosystems
tertiary consumers, 424
See also consumers (in ecosystems)
Tertiary Period, 359, 370–71, 374–75
test dummies. *See* crash test dummies
theory of catastrophism, 314–15
theory of continental drift, 354
theory of evolution. *See* evolutionary theory
theory of natural selection, 499–503
theory of uniformitarianism, 315, 317, 319
thermal cracking process, 141, 143
See also petroleum
threatened species (table), 457
three-dimensional diagrams, 28
See also diagrams of atoms and molecules
thrush, song, 496
Tierra del Fuego beavers, 506
time, deep, 294–95, 303, 319
See also Geological Time Scale
time, in graphs
distance-time graphs, 169
position-time graphs, 187, 189, 192
See also velocity-time graphs
toboggans, 227
tourism and biodiversity, 459
towns, prairie dog, 416–17
toxic materials
WHMIS safety cautions, 529
trace fossils, 304, 331
See also fossils
traffic safety
acceleration lanes, 206–7
area of no return, 216–17, 220
traffic intersections, 216–20
traffic rules in Alberta, 205–6, 209
See also vehicle safety; vehicle stopping distance
transect and base line (field study), 434
transpiration, 442
transverse waves, seismic, 347
trees. *See* boreal forest ecosystems; forestry and forestry industry
Triassic Period
average global temperature in, 384
geological and life forms in, 357
in Geological Time Scale, 312, 557
trilobites (fossils), 312, 330, 333, 356, 362
trophic levels (in ecosystems)
about levels in ecological pyramids (diagrams), 425–27, 432, 441
in food chains and food webs, 428, 441
four-step process in cycles, 466
tropical rain forests (map), 458
tsunamis, 350
tube and marbles (activity), 241, 248

U

UMD (uniform motion device). *See* uniform motion
U.N. Intergovernmental Panel on Climate Change (IPCC), 393
U.N. World Heritage Sites, 335
unconformity (geology), 315, 317–18
UNESCO World Heritage Sites, 414
uniform acceleration, 198
See also acceleration
uniform motion
about uniform motion, 169, 173
position-time and velocity-time graphs, 187–90, 192, 195
uniformitarianism theory, 315, 317, 319
units of measurement
conversion factors, 172, 532
in ecological and economic systems, 461
SI and non-SI units (tables), 530–31
unsaturated hydrocarbons, 123
See also hydrocarbons, saturated and unsaturated
uranium, 322, 557

V

valence electrons, 12–13
Vancouver Island earthquake (1700), 350, 363
variation (adaptations), 494, 496
vectors
about vectors, 180–81, 185
when to drop vector notation, 199, 204, 212
vegetable oils, 124–25, 133, 135

vehicle braking
about braking and friction, 221
about braking distance, 215
as force of friction, 226
net force in, 221, 226
See also Newton's second law; vehicle stopping distance
vehicle collisions
categories of collisions (hit and stick, hit and rebound, explosions), 265–67, 271
classes of collisions, 257
conservation of momentum and, 268–71
crash barriers, 252, 254
eye injuries in, 186
momentum and, 265–67
Newton's third law and, 258–62
vehicle safety
carrying passengers on motorcycles, 234
crash test models, 187
head restraints, 232–33
"no zones," 222
seat belts, 232–33
technological advancements, 174–78, 255, 257–58
vehicle stopping distance
about braking and reaction distance, 214–15
about determining stopping distance, 215–18, 220
area of no return, 220
reaction time, 167, 214–15
at traffic intersections, 216–20
See also vehicle braking
velocity
average velocity, 181–83, 185
momentum and, 243, 245
zero initial acceleration equation, 204
velocity-time graphs
about use in acceleration problems, 203–4, 212
in accelerated motion, 195, 198–99, 203, 206
in negative acceleration, 202, 204
in uniform acceleration, 198–99
in uniform motion, 190, 192, 195
use of displacement equation to replace, 207
vinegar, 34
volcanoes
climate change and, 357, 386
formation of, 298, 352–54
mass extinctions and, 356–57
radioactive dating of, 322, 323
succession on solidified lava, 470–71, 508
voltaic cells (batteries)
about voltaic cells (diagram), 86–88, 94
analysis of processes (diagrams), 89–91
anodes and cathodes in, 89–91, 94
for consumer use, 93, 100
electrolytic cells, comparison (diagram), 95
rechargeable cells, 100
See also batteries
volume, percent by (solutions). *See* solutions, concentration of
Vostok Ice Core, 378, 387
***Voyager 2*,** 231
vulnerable species (table), 457

W

Wallace, Alfred Russel, 501
warblers, yellow, 417, 424–28, 430
water and society
daily consumption log, 412
drinking water, allowable toxic levels (table), 42–43
drinking water, sources, 380–81
human impacts on water, 442
oilfield injection processes and (diagram), 410–11
pollution from automobiles, 111
water cycle
about water cycle, 442–43, 466
oilfield injection processes and (diagram), 410–11
in oxygen cycle (diagram), 448–49
water in ecosystems
as abiotic factor in, 406–7
in living cells, 30
in oxygen cycle (diagram), 448–49
See also aquatic ecosystems
water molecules
about models and diagrams of, 13, 28
in aqueous solutions, 26–31, 33
breaking chemical bonds, 33
charge distribution (diagrams), 28–30
combustion of hydrocarbons (diagram), 145
electrolytes and (diagram), 31
non-electrolytes and, 31
three-dimensional diagram, 28
See also solutions
waterfleas, 429
Waterton Lakes National Park, 294, 302, 366
waves, seismic, 345–49
waxes, 132
weather and climate, 382, 393
See also climate change
webs, food, 428–32, 441
Wegener, Alfred, 354
welding, oxy-acetylene, 127
West Coast crustal plates (map), 363
whiplash, 232–33
See also Newton's first law of motion
WHMIS, 528–29
wildfires. *See* fires
Wisconsin Glaciation, 367, 379–81, 383
See also glaciations and glaciers
Wöhler, Friedrich, 110
wolverine, 457, 458
wolves, 456
Wood Buffalo National Park, 19
Wood Mountain, Saskatchewan, 370
woolly mammoths, 377
word descriptions for chemical equations, 61–62
work
SI symbols and units, 530
work and energy, 274
world, maps
boreal forests and tropical rain forests, 458
Darwin's travels, 497
ice sheets, 379
ocean currents, 385
Pangaea (supercontinent), 355, 358
satellite image of temperatures, 382

X

Y

yellow warblers, 417, 424–28, 430
Yellowstone National Park, 303

Z

zebra mussels, 459
zircons, 322